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Cements based on kaolinite base waste

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The cement industry is of high-energy consumption, being able to generate high CO_2 emissions into the atmosphere. Environmental concerns can be solved by replacing part of the Portland cement clinker with pozzolanic materials in mortars and concrete. Slag, fly ash or silica fume are materials used for the planned replacement. Research studies based on clay minerals, as kaolinite, are being followed with special attention from the scientific community of the cement industry. It is well known that these minerals require an activation process to transform kaolinite (K) into metakaolinite (MK). The production of MK reduces the amount of energy used and CO_2 emissions. MK is an amorphous material from the transformation of K, with a high pozzolanic activity, that is, its capacity to react with the portlandite released during the hydration of Portland cement, generating compounds such as C-S-H gels and some aluminum-phase hydrates. The main mineralogical compounds obtained as results of pozzolanic reaction are hydrated calcium aluminate and hydrated calcium carboaluminate.

In developed countries, either because the availability of these by-products or transport are expensive, pre- viously calcined clay clays are used, since it is an abundant material and an alternative as a pozzolanic addition.

The current use of cementitious materials for eco-efficient cements is based on industrial waste. The clay is the most reactive state to activate the material by temperature since it produces a destruction of the structures initiating by the elimination of the hydroxyl groups of the laminar bridges.

One of the MK production methods is the heat treatment controlled from kaolinite at temperatures in the range of 600º/900ºC. The activation of industrial waste with a kaolinitic base is a way to obtain reactive MK from different sources such as calcined paper sludge, calcining waste from laundries in coal mines, sludge generated in drinking water treatment plants. The reuse of this sludge as a pozzolanic addition in the manufacture of eco-efficient cements is an alternative to their elimination, due to their silicoaluminous properties.

Due to its good behaviour as future eco-efficient additions, this research is a study by FRX, XRD and SEM / EDX of their influence on the performances of blended cement mixtures (binary and ternary one), with substitutions of pozzolan ratio at 28 days of hydration. Porosity of pozzolanic cements decreases because of the formation of hydrated phases during pozzolanic reaction. Due to the reduction of pores, because of the growing of the hydrated compounds that have hydraulic properties, the compressive strength increases.

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